

## CANADA'S NATIONAL CALIBRATION REFERENCE CENTRE FOR BIOASSAY - PRESENT PROGRAMS AND FUTURE DIRECTIONS

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### ABSTRACT

In 1983, the Radiation Protection Bureau of the federal Department of Health was formally recognized by the Canadian nuclear industry regulator, the Atomic Energy Control Board (AECB) as the National Calibration Reference Centre (NCRC, the Centre) for Bioassay and *In Vivo* Measurements. The Centre's mandate was to provide practical reference standards to the AECB's licensees for measurements they use to assess doses resulting from radionuclide intakes by their workers. These standards are offered in the form of annual intercomparisons which provide the external verification required by the AECB on a regular basis. *In vivo* programs are administered by the *In Vivo* Section, while bioassay programs are administered by the Bioassay Section of the Radiation Protection Bureau. This paper will describe only the intercomparisons and related services offered by the Bioassay Section. Plans for the establishment of new programs will also be described.

### INTRODUCTION

The AECB's choice of the Bureau to act as the national reference centre for internal dosimetry measurements is based on recognition of its expertise in this area gained through many years of experience in bioassay, *in vivo* measurements and internal dosimetry. The impetus for the formation of the centre is the desire of the AECB to have a means for obtaining both external verification of licensee monitoring results and assessing the comparability of results submitted to it by its various licensees.

### PRESENT PROGRAMS

Currently, Bioassay Intercomparisons include urinalysis programs for uranium mass measurement, tritium, carbon-14 and fission/activation products. A program where tritium and carbon-14 are simultaneously present (the Dual Spike Program) in the urine matrix is also available. All intercomparisons are offered regularly on an annual basis.

### PARTICIPANTS

Three Canadian provinces meet part of their electrical requirements with power provided by CANDU reactors. Canada's uranium industry produces uranium for these nuclear stations as well as for export to other nuclear power producing countries. The in-house bioassay laboratories for these facilities participate in the Centre's programs, as do the laboratories in a tritium-producing facility and an organization that provides bioassay measurements for internal dose assessments for occupational and environmental exposures. Several radiopharmaceutical companies, one Canadian and the rest from the United States, also participate in the NCRC's Bioassay Intercomparisons.

### CHARACTERISTICS OF PROGRAMS

In all programs, natural human urine is used as the sample matrix. A blank is provided for each spiked urine standard. This urine blank is used by the participant for MDA determinations as well as to matrix-correct their

spiked urine calculations. For the Uranium, Tritium and Carbon-14 programs, participating laboratories are asked to measure three radionuclide concentrations which reflect levels encountered in the workplace in routine and non-routine monitoring situations. For the Dual Spike Programs, one combination of tritium and carbon-14 is provided, the ratio of which is varied from one intercomparison to the next. For the Fission/Activation Products Program, participants are expected to identify as well as quantify radionuclide components. One concentration of each of three to four radionuclides is given for gamma spectrometry analysis. Enough urine sample is also provided for those laboratories who use beta-counting as a screening procedure for fission/activation products internal contamination. Because the AECB requires the assessment of repeatability (precision) performance of its licensees in these programs, several randomly coded replicates are provided for each spike concentration (five for the Uranium, Tritium, Carbon-14 and Dual Spike Programs and three for the Fission/Activation Products Program). Laboratories are given 30 days from date of shipment of urine standards to submit their results reports to the NCRC. Once all participants' results are received by the NCRC, information on true spike levels are sent by fax to each participating laboratory. A final performance report showing results but protecting the anonymity of all laboratories in tables and figures are sent to each laboratory and to the AECB ninety days after sample shipment. Each laboratory is identified by a number code in the tables and figures. These codes are revealed only to the particular participant and the AECB.

### BENEFITS OF PARTICIPATION

The primary benefit derived from participating in the Centre's intercomparisons is the opportunity to satisfy the regulator's (AECB) licensing requirement to participate in a program that tests the licensee's capability to perform the measurements that it uses to monitor personnel internal radioactive contamination. Testing is done on an annual basis. The regulator is able to verify the accuracy of each licensee's results, as well as the comparability of results among various licensees performing the same measurement. Figure 1, drawn from a recent Uranium Intercomparison, shows how the regulator is able to conduct an easy appraisal of how each licensee compares with its peers (between-laboratory variability) as well as whether or not the mean relative bias of submitted results are within the S-106 regulatory standard's [1] prescribed limits of -0.25 to +0.50 of the added spike levels. The spike level used for this particular test is 149 . g U/L. The NCRC guarantees both the spike levels at +/- 5% and the homogeneity of the urine matrix so that each laboratory is tested with the same 'yardstick' as other participants. Further, because we give several randomly coded replicates of the each spike level, the regulator can assess true precision (repeatability) of licensee results.

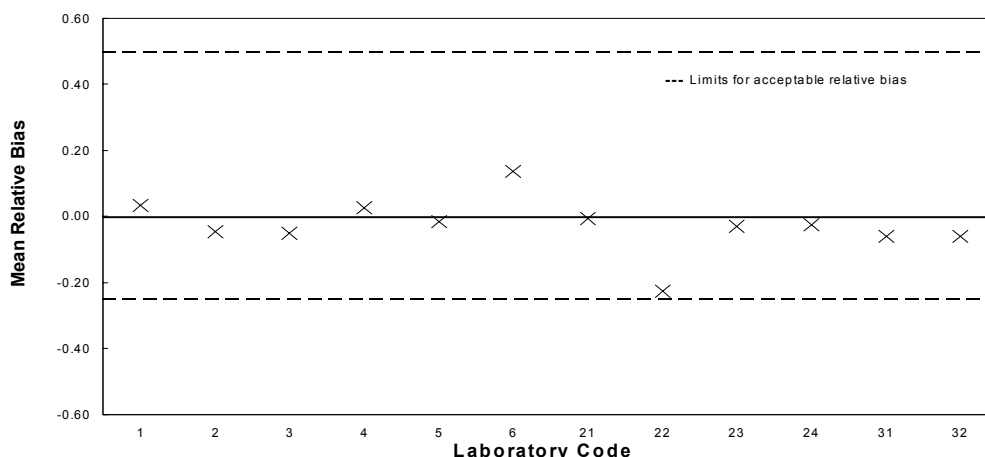


Figure 1. Uranium urinalysis intercomparison mean relative bias chart.

Managers can use - and have used - our urine standards to compare performance among several of their analysts (between-analyst variability) and also be certain that they are being tested with the same 'yardstick' because as

stated above, samples are drawn from the same NCRC-certified stock standard whose homogeneity the Centre guarantees.

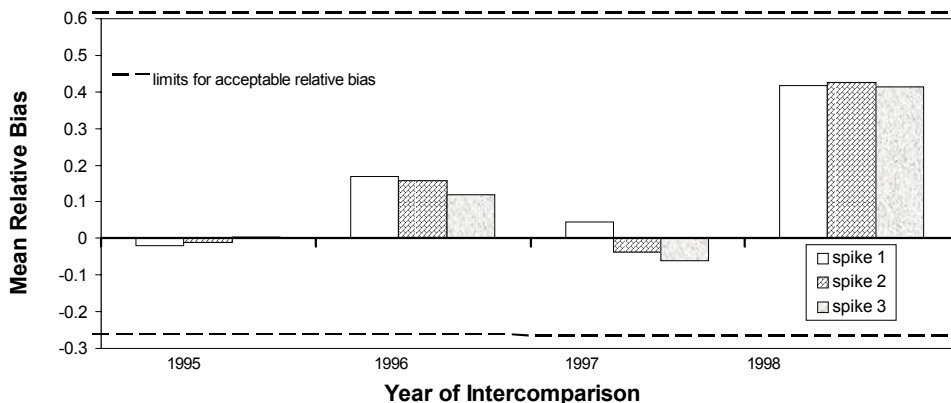


Figure 2. Verification of measurement accuracy for carbon-14 intercomparison program

Managers can also use intercomparison results to monitor lapses in analyst performance. Figure 2 above shows how after acceptable performance over a three-year period, the bias of results increases dramatically to close to the upper limit of acceptable bias. Spike levels tested are listed in Table 1. Note that as shown in Table 1, the precision for all three spike levels is between 1 and 2 % , which is well within the AECB’s performance criterion of 0.40. Without external verification, the increase in measurement bias could have easily been missed.

Spike Level (Bq/L)	Mean Relative Bias	Relative Precision	Analyst
5.41E+03	0.418	0.018	B
1.59E+04	0.427	0.019	B
2.68E+05	0.415	0.008	B

Table 1. Carbon-14 intercomparison results, 1998

A historical database is maintained for each participant of all intercomparison results submitted to the Centre to date, as well as information on measurement performance. This database can be of great use to the regulator or perhaps, a prospective client of a bioassay laboratory.

## OTHER SERVICES OFFERED

In addition to the intercomparisons, the NCRC also conducts, on request, bioassay measurements and dose assessments for suspected radionuclide intakes. The Centre has an interest in radionuclide metabolism, biokinetics and the bioeffects of internal contamination and will conduct research studies in these areas, usually in collaboration with other agencies. Advice and training on instrument use and bioassay measurement techniques can also be provided upon request.

## FUTURE PROGRAMS

Preparations are now in progress for the eventual offering of the following urinalysis intercomparisons: (1) Organically bound tritium, (2) Pu 239/240, (3) Am-241.

## REFERENCES

1. Atomic Energy Control Board, *Technical and Quality Assurance Standards for Dosimetry Services in Canada*. Regulatory Standard S-106, March 20, 1998.